AAM

AIRSPACE WORKING GROUP

The National Airspace System (NAS)

LS TECHNOLOGIES, LLC

Trusted Experience. Practical Solutions.

National Aeronautics and Space Administration

NASA

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Terminal Operations (Tower and TRACON)

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Date: 9/22/2020

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Breadth of NAS – Operations

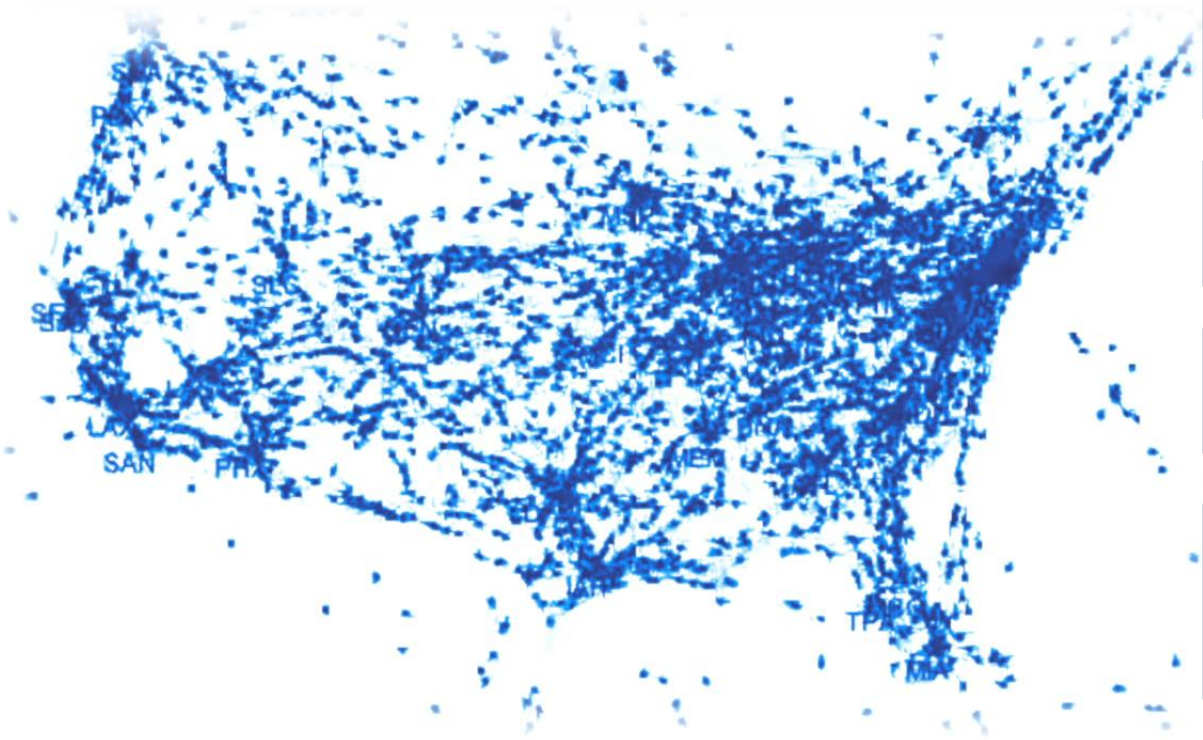
Airports
- 19,622 Public / Private
- 5,092 Public

Air Traffic Towers - 518 (2018)
- 264 - Federal
- 254 - FAA Contract

Terminals - 157 (2018)
- 154 - Approach Control
- 3 - Offshore Sites

En Route Sites
- 21 - ARTCCs
  - 775 - Sectors

Oceanic Sites
- 3 Centers (ZAN, ZOA, ZNY)



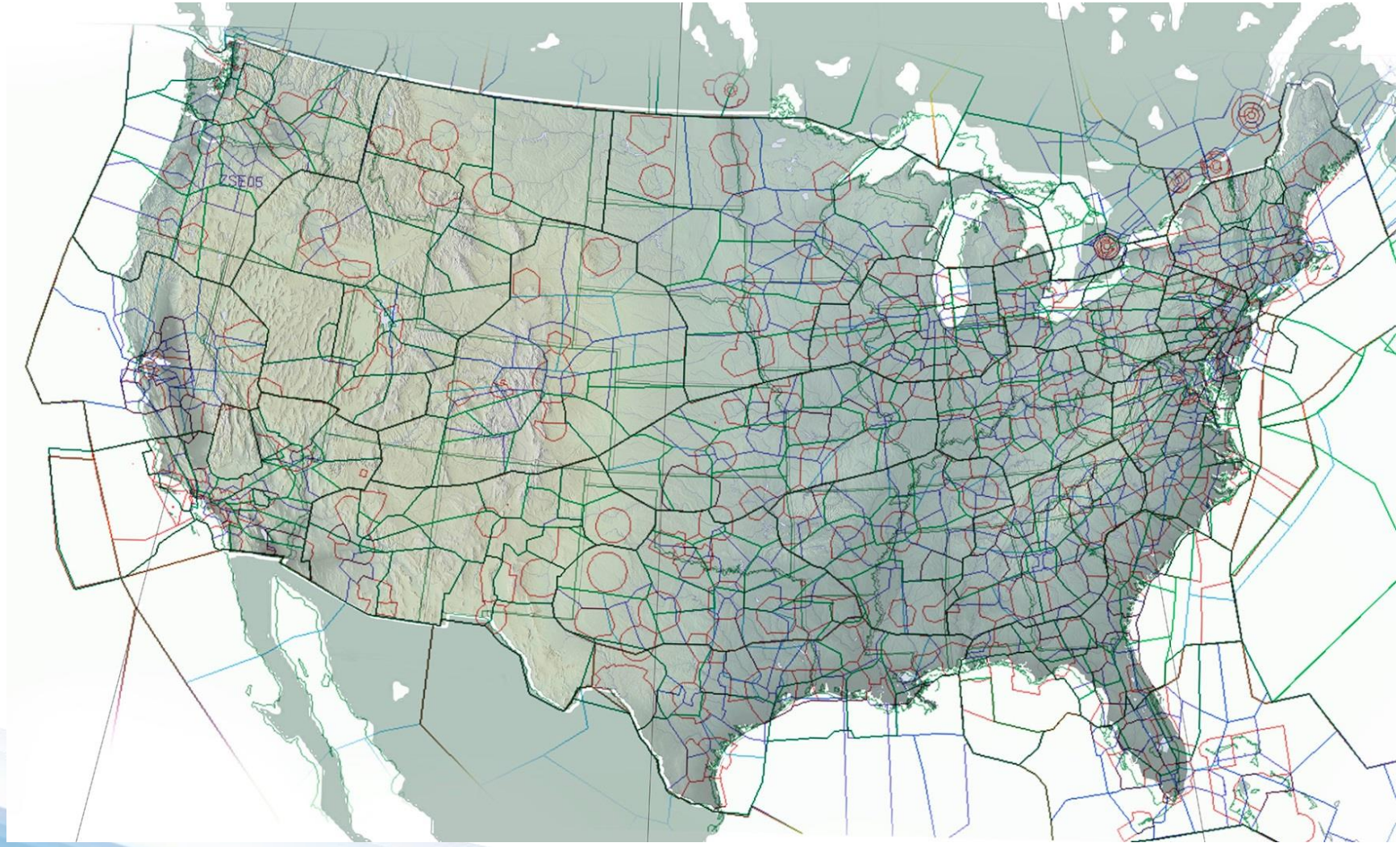
Total Aircraft
~ 220,000 (Commercial & GA - 2020)

Flights Handled by FAA
- Over 44,000 flights per day

US Passenger Enplanements
- Over 1 Billion (2019)

Operational Personnel
- 14,695 Controllers (2018)
- 664,565 Pilots (Active Airmen Certs 2019)
- 160,302 Remote Pilots (2019)

EnRoute Sectors & Terminal Airspace



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Tower Operations in General

- There are 518 ATC Towers in the United States, made up by FAA and FAA contract Towers.
- Air Traffic Controllers working in tower cabs manage traffic within a radius of a about 3-5 five miles of the airport from the surface up to 3000 feet.
- Depending on the airport layout and/or size of the tower cab, there can be more than one of the same types of position on duty. e.g., multiple Local or Ground controllers.
  - This becomes especially important when certain types of operations are in progress such as independent simultaneous approaches to parallel runways
  - Very large airports
- ATCT and TRACON are sometimes separate facilities at large airports

The Tower Team

- **Ramp Control (not typically FAA in large Towers)**
- **Ground Controller (1 or more)**
- **Local Controller (1 or more)**
- **Clearance Delivery**
- **Flight Data**
- **Traffic Management Coordinator (TMC)**
- **Tower Associate (Floater)**
- **Special Operations (Helo, LE, Medical)**
- **Tower (Cab) Coordinator**
- **Supervisor/Controller in Charge (CIC)**

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Ramp Control "Pushback"

- The first physical movement of the aircraft is the pushback.
- The flight crew receives approval from the FAA or other authority, such as ramp control, to push back from the gate.
- The tug is connected to the aircraft, the jetway is removed, and the airplane is pushed back (off the blocks) from the gate and movement ques are activated (TFMS, ASDE, etc.)
- The engines are started, and the Flight is underway
- The Aircraft taxis to a control spot and contacts Ground Control

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Ground Control Taxi for takeoff

- **The GC position is responsible for controlling all the airplanes on the airport surface, except for the runways. The pilot contacts the Ground Control (GC) Position in the control tower and requests clearance to taxi.**
- **The ground controller reviews the flight plan and determines which runway the airplane should depart on based on the aircraft type, wind, airport configuration, direction of flight, and other considerations.**
- **The ground controller issues a taxi clearance to the runway. The clearance includes the taxiways to use, traffic to be aware of, instructions to follow other aircraft, and establishes the departure sequence etc., they also must comply with ground lighting systems (RWSL, Wig-Wag, etc)**
- **The pilot reads-back the clearance and taxis to the runway.**
- **When at the appropriate location GC will tell the pilot to contact, or monitor "Tower"**

Local Control Takeoff

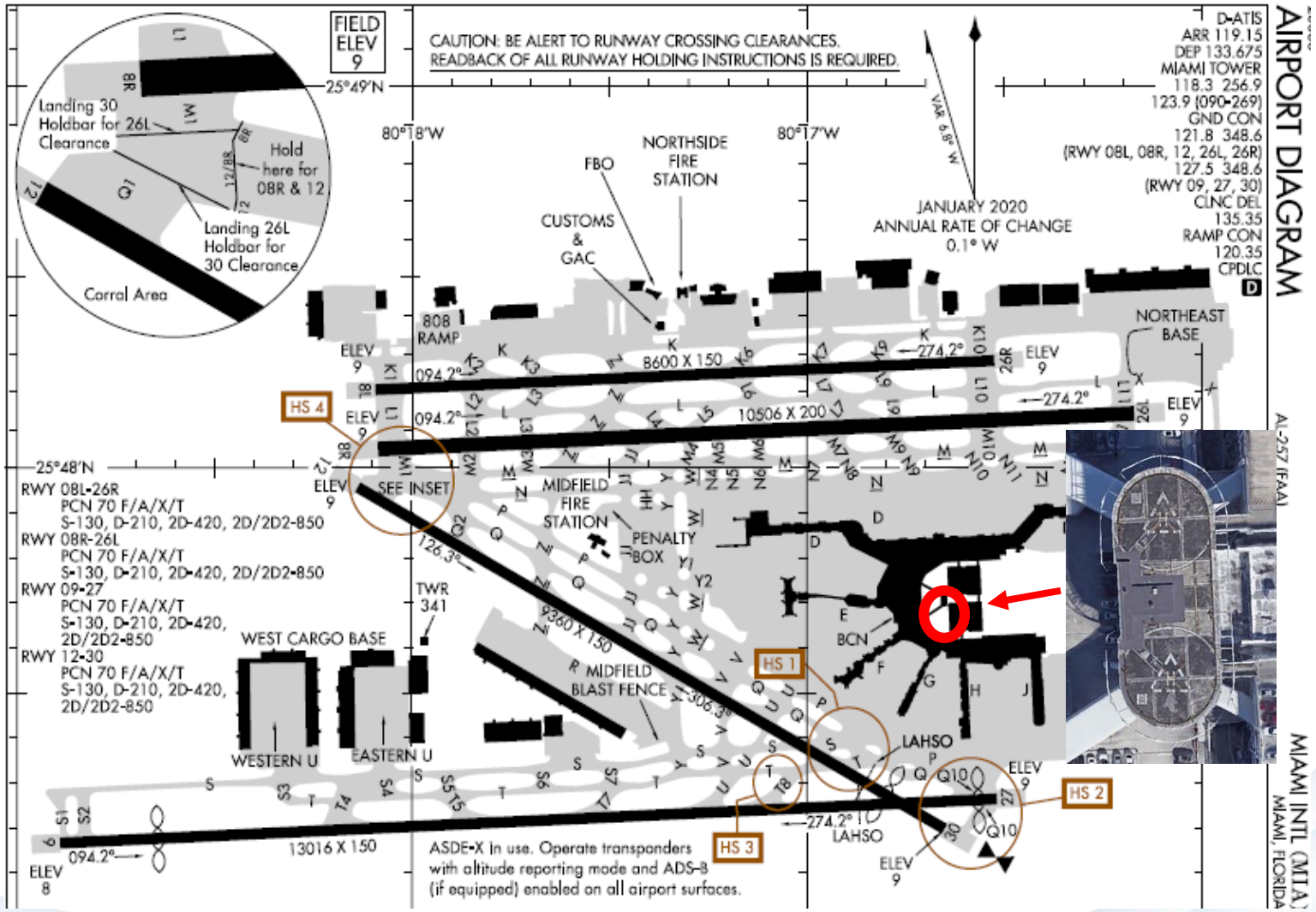
- **If the flight has any restrictions on it, such as a controlled time of departure, the local controller ensures compliance with these requirements.**
- **When the runway environment is safe and the airspace is clear, the local controller gives the pilots instructions for the initial heading and altitude to be flown and clears the aircraft for takeoff.**
- **The aircraft departs and flies the initial headings and altitude received from the tower controller.**
- **When the aircraft is about a mile from the airport and tower confirms heading and data block acquire, the pilot is instructed to contact departure control or just “contact Departure”.**

Local Control Landing

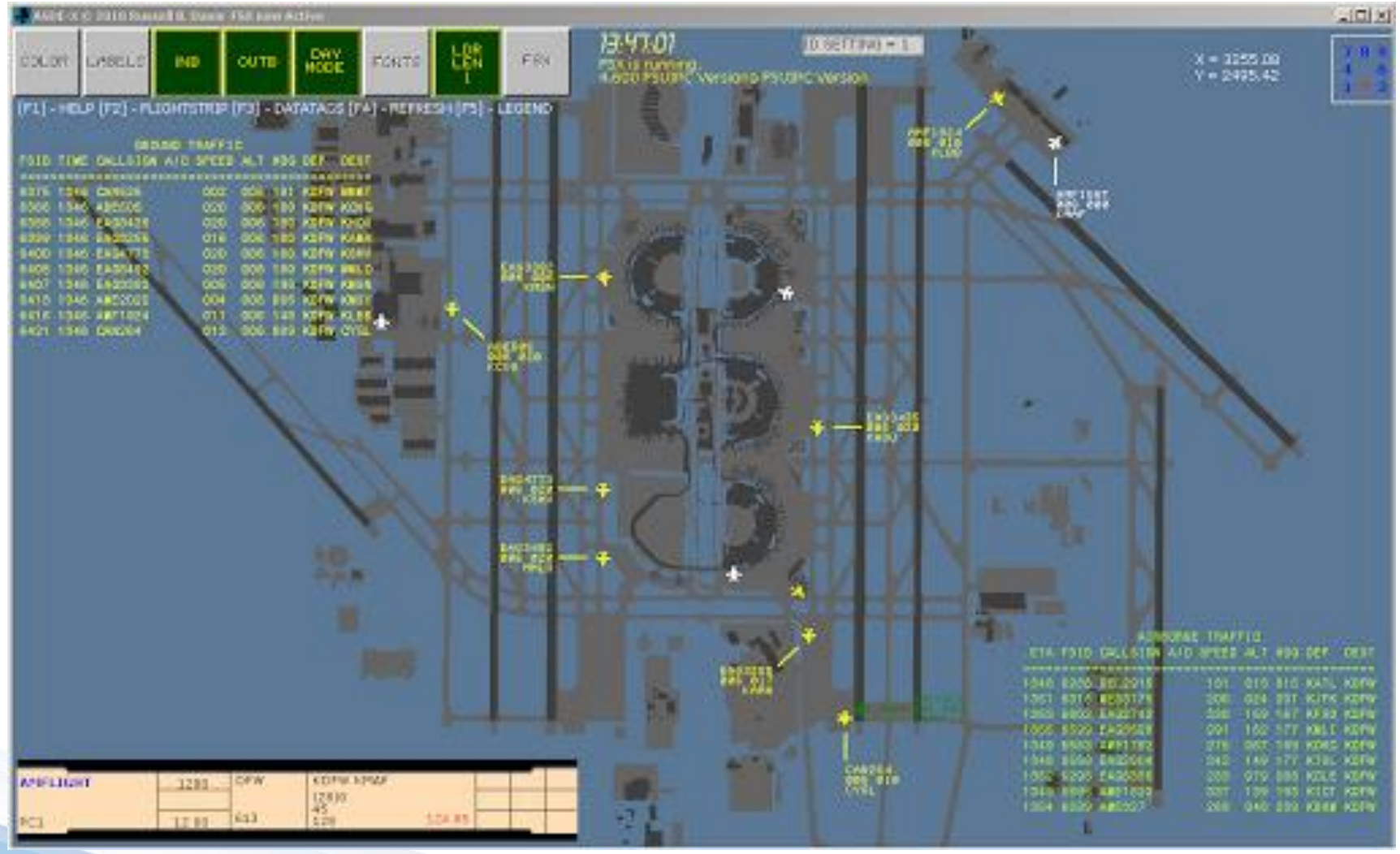
- When an arriving aircraft is about 5 miles (or just inside the OM) from the runway, the pilot contacts the “Tower” controller.
- The Tower controller ensures separation for the remainder of the flight, ensures the runway environment is safe, provides the wind direction and speed, and any other necessary instructions.
- When everything is safe, the tower controller issues a landing clearance, and monitors the remainder of the flight and the landing.
- The tower controller is usually working arrivals and departures on the same or parallel runway, so they must blend all the flights to make safe and efficient use of the runway.
- When the airplane has landed, the tower controller tells the pilot where to exit the runway. When the aircraft has exited the runway, the pilot is instructed to contact Ground Control.

Ground Control
Taxi to the Ramp or Gate

- **As the aircraft exits the runway, the pilot contacts the Ground Controller and tells the controller the Gate assignment.**
- **The Ground Controller determines the best taxi route to use, and issues a taxi clearance to the aircraft, along with the route to be used.**
- **The Ground Controller ensures the aircraft remains clear of other runways and resolves traffic conflicts with other taxiing aircraft and is instructed where to enter the Ramp area.**
- **As the aircraft approaches the Ramp area, Its instructed to contact Ramp Control. It leaves the taxiways (movement area) and enters the Ramp and tells them their Gate assignment.**
- **Personnel from the airline guide the airplane into the gate. (In the Blocks)**
- **The engines are shut down, and the flight is complete.**

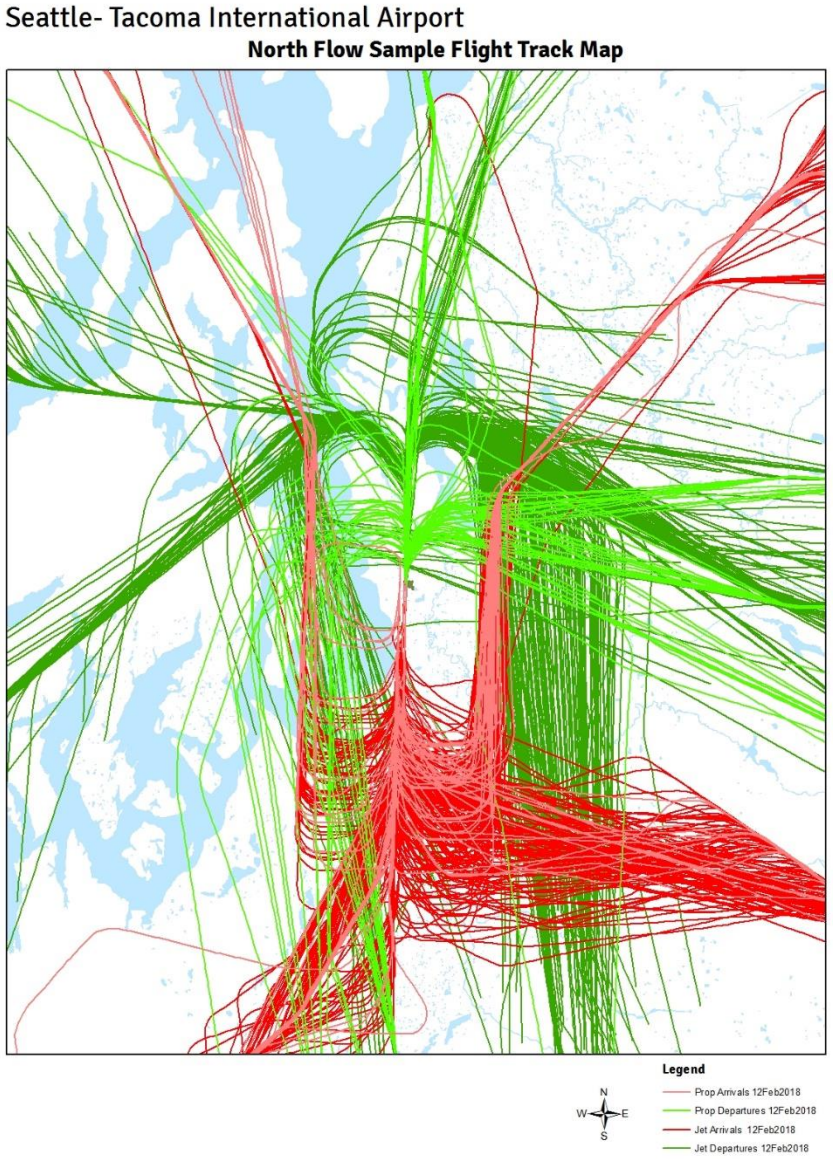


Surface Radar – ASDE-X



Tower TRAFFIC Management Coordinator (TMC) Duties

- Sometimes referred to as Flow Control
- Responsible for the flow of traffic to and from airport
- Responsible for impact to the National Airspace System (NAS) Traffic Flow Management initiatives
- Uses Traffic Flow Management System (TFMS)
- Gathers and monitors weather (WX) information
- Coordinates with TRACON TMC and ARTCC TMC
- Notifies appropriate facilities concerning local Traffic Management initiatives
- Administers Traffic Management Initiatives (TMI)
- Analyzes and reviews TMI's for effectiveness and adherence
  - EDCT (Controlled Departure Times)
  - Delays
  - Reroutes
  - Runway Usage Programs



Front Line Manager (FLM) / Controller in Charge (CIC) Duties

- **Responsible for the overall operation of the ATCT**
- **Supervises controllers**
- **Position Assignments**
- **Generally works closely with the TMC with shared duties**
- **Ensures all operations are safe and following FAA requirements for separation of aircraft**

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TRACON

(Terminal RADAR Approach Control)

TRACON Operations in General

- There are 154 TRACONs in the United States
- Air traffic controllers at TRACONs typically control traffic within a 40-60-mile radius of the primary airport at altitudes up to 10,000-16,000 and some as high as 20,000.
- They control departing and arriving flights and provide clearances for aircraft in the TRACON's airspace at other than the primary airport as well as tower enroute control.
- TRACON controllers ensure that aircraft maintain minimum separation distances between landing and departing aircraft, transfer control of aircraft to tower or ARTCC controllers when the aircraft leave their airspace and receive control of aircraft for flights coming into their airspace.
- TRACON airspace is divided into sectors that often provide services to multiple airports.
- The airspace is divided into areas of specialization based on the type of work being done, each of which contains groups of sectors.

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Terminal Automation

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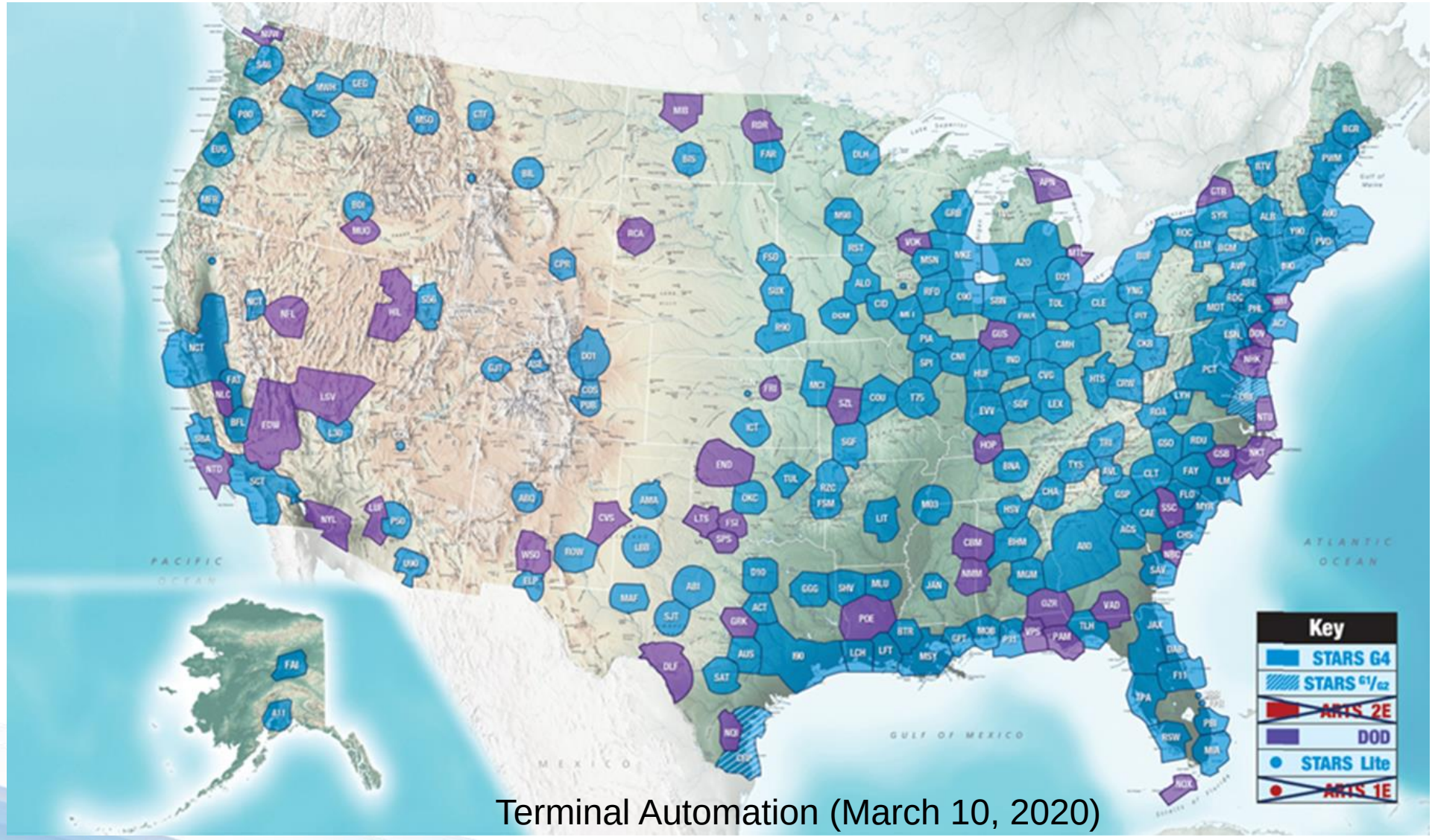

Terminal Automation (March 10, 2020)

TRACON Phases of Flight

- **Departure**
  Identification, altitude verification and continue climb
- **Initial Ascent**
  Transitions from the Terminal environment to the ARTCC (headings and altitudes)
- **Initial Descent**
  Transitions from the ARTCC back the Terminal environment.
- **Descent (or Feeder)**
  Vectors/Sequences to the final approach course
- **Final Approach**
  Ensures final approach capture, spacing approach clearance, and transfer to Local Control (Tower)
- **Monitor**
  Larger facilities and those with closely spaced parallel runways utilize monitor position to ensure lateral and longitudinal separation

TRACON Team

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Flight Data/Clearance Delivery

- **Flight Plans**
- **Clearances**
  - **Departure Controller (ID)**
  - **Departure Controller**
  - **Continue climb and transition to the ARTCC**
- **Arrival**
  - **Descends out of the ARTCC environment into the Terminal environment (by post)**
- **Feeder**
  - **Continues descent and starts the sequence and vectors to the final approach course**
- **Final**
  - **Establishes final vectors and clears for the approach**
- **Monitor**
  - **Monitors close in approach tracks and makes adjustments if necessary**
- **Satellite**
  - **Works aircraft away from the major flows and provides practice approach, VFR advisories, clearances and other radar services to satellite airports**

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Departure

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- When the flight departs the airport, the pilot is instructed to contact the departure controller, who is working in the TRACON.
- The controller identifies the flight on radar to ensure positive identification using the aircraft's transponder code, which was assigned as part of the IFR clearance and verifies the pilot's altitude readout (±300')
- The departure controller assigns instructions for the aircraft to establish it on its route of flight and continue climb to a transition altitude assigned by the ARTCC.
- When the aircraft is about forty miles from the airport, or at an appropriate altitude, the controller makes a handoff to the ARTCC
- A handoff is an automated transfer of radar identification to another controller, to transfer control responsibility.
- When the ARTCC controller is satisfied that they have positive identification, and everything else is in order, the flight is instructed to contact the ARTCC controller on another frequency.
- The ARTCC controller will integrate the flight into the overhead Enroute high-altitude environment.

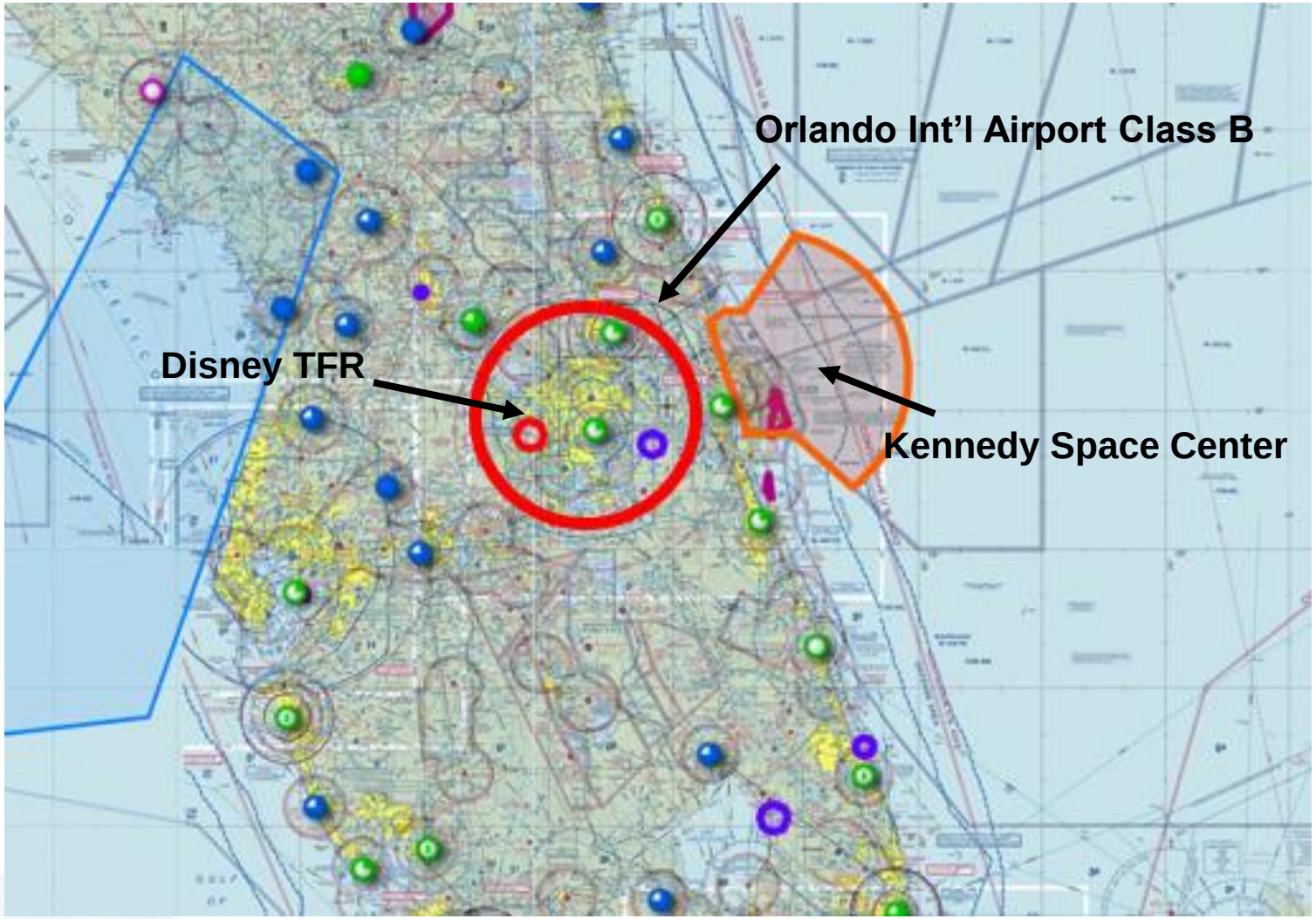
Approach Control

- **The approach controller begins working the flight about 40-60 miles from the airport at an altitude of about 10,000-16,000 feet.**
- **The Pilot will inform the controller that they have the current ATIS information. The controller then advises the pilot what the landing runway will be and what approach will be flown to the runway (ILS, visual, RNAV/GPS, etc.)**
- **The controller begins the initial descent and will adjust the flights speed, altitude and heading as necessary to sequence the flight with other arriving traffic.**
- **When the aircraft is properly separated from other aircraft, and it is at the correct speed, heading, altitude, and in the proper position, the TRACON controller does another handoff and frequency change to the "Final Controller".**

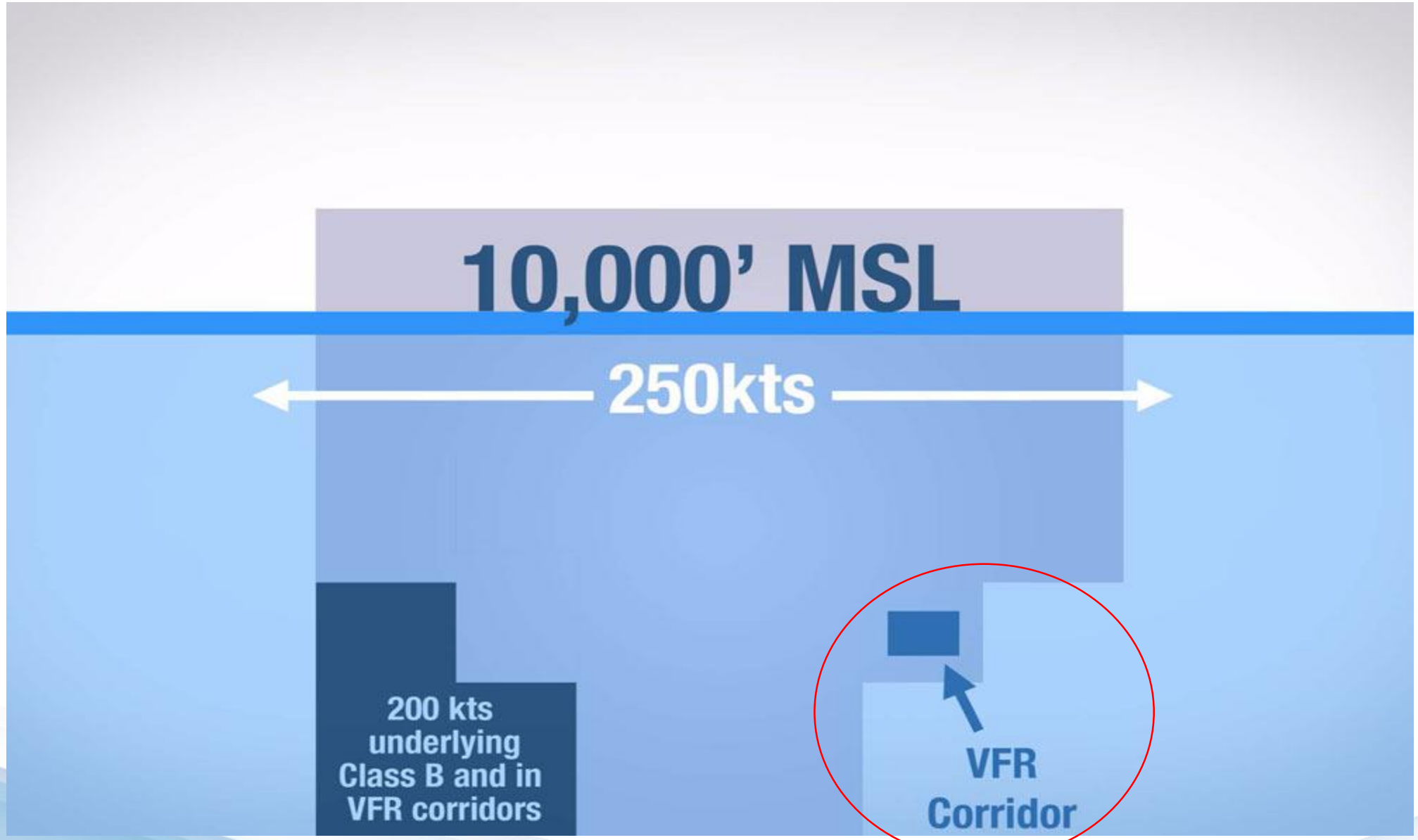
Final Approach

- When the flight is 20-25 miles from the runway it is worked by the final controller.
- The final controller makes final adjustments to the flight (heading, speed, altitude), ensures it is properly separated from other traffic, and clears the airplane for an approach to the runway.
- The airplane now begins following the guidance of the instrument approach procedure it was cleared for. The approach procedure provides lateral and vertical guidance to the runway environment.
- An approach is not a landing, it is a means of providing horizontal and vertical navigation guidance to the aircraft to get the aircraft close to the ground and below the clouds so the pilot can see the airport and safely land.
- The final controller will ensure proper spacing of the flight behind the preceding aircraft. Normally this is 3 miles, but it can increase to as much as 8-10 miles depending on Wake Turbulence criteria.
- When the flight is 5-7 miles from the airport, the Final Controller does a handoff and frequency change to the Tower.

Area of Focus



Class B – Cross-section View



Airspace Considerations

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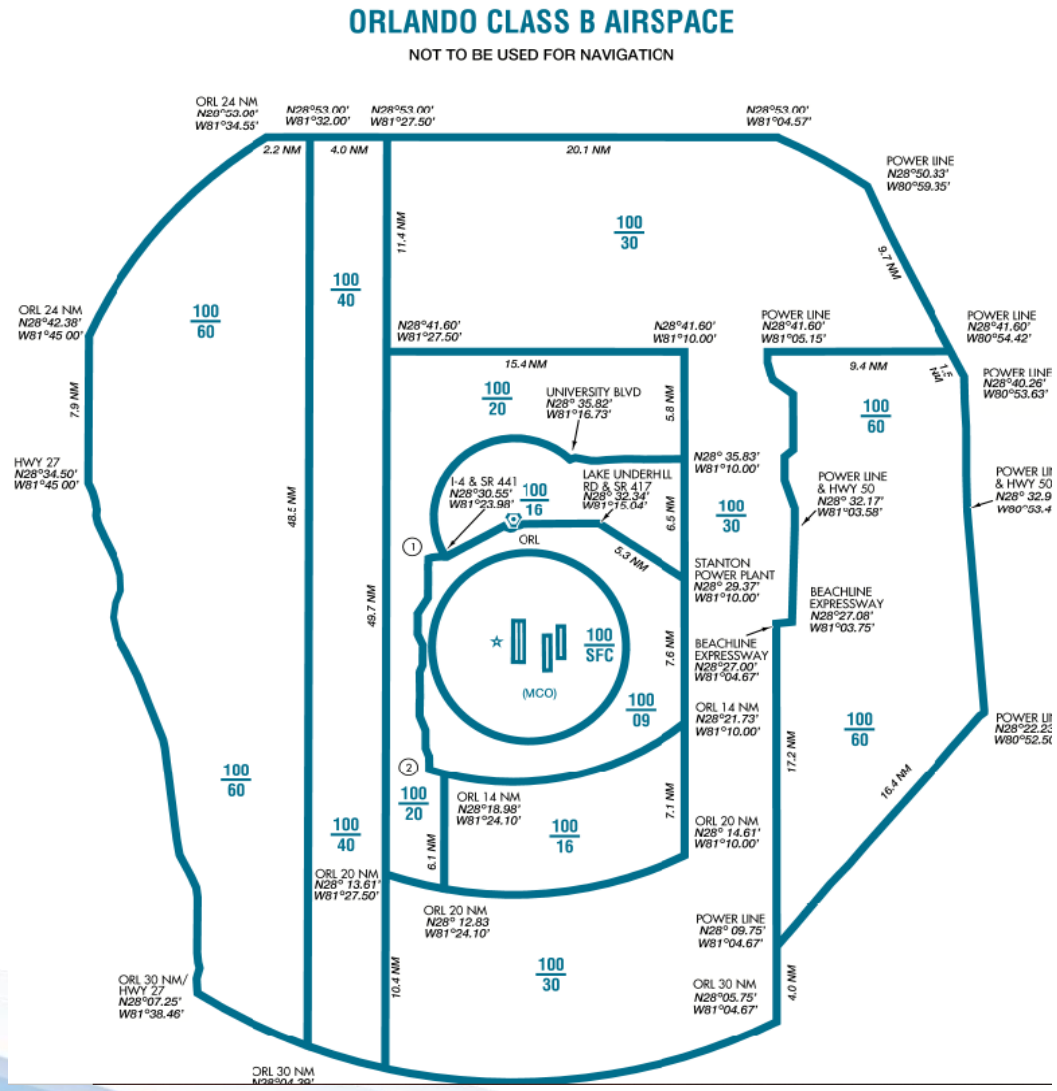
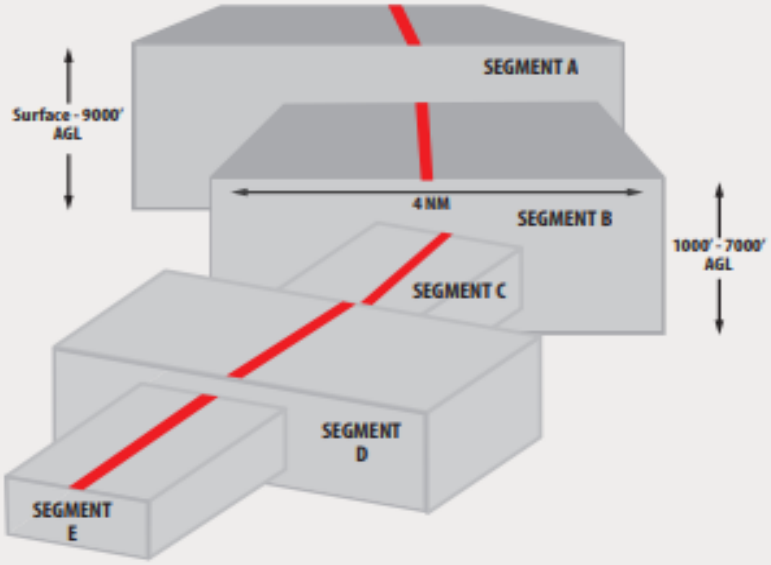


Military Training Routes

National security and military readiness require our armed forces to train in a wide range of airborne tactics, including low-level combat tactics at high speeds. Military Training Routes (MTRs) are designated air corridors, mutually developed by the FAA and the Department of Defense, for low-altitude, high-speed military flight traffic and training. MTRs are defined by a series of segments along the centerline of the route with horizontal and vertical dimensions. Horizontally, MTR segments show the variation of the route's width from the centerline. Vertically, the segments vary by floor height. MTRs are typically established below 10,000 feet mean sea level (MSL), and military aircraft can conduct operations in excess of 250 knots (287.7 miles per hour). MTRs are divided into Instrument Routes (IR), Slow Routes (SR), and Visual Routes (VR).



Graphics courtesy NAS Fort Worth JRB

A Detailed Airspace View

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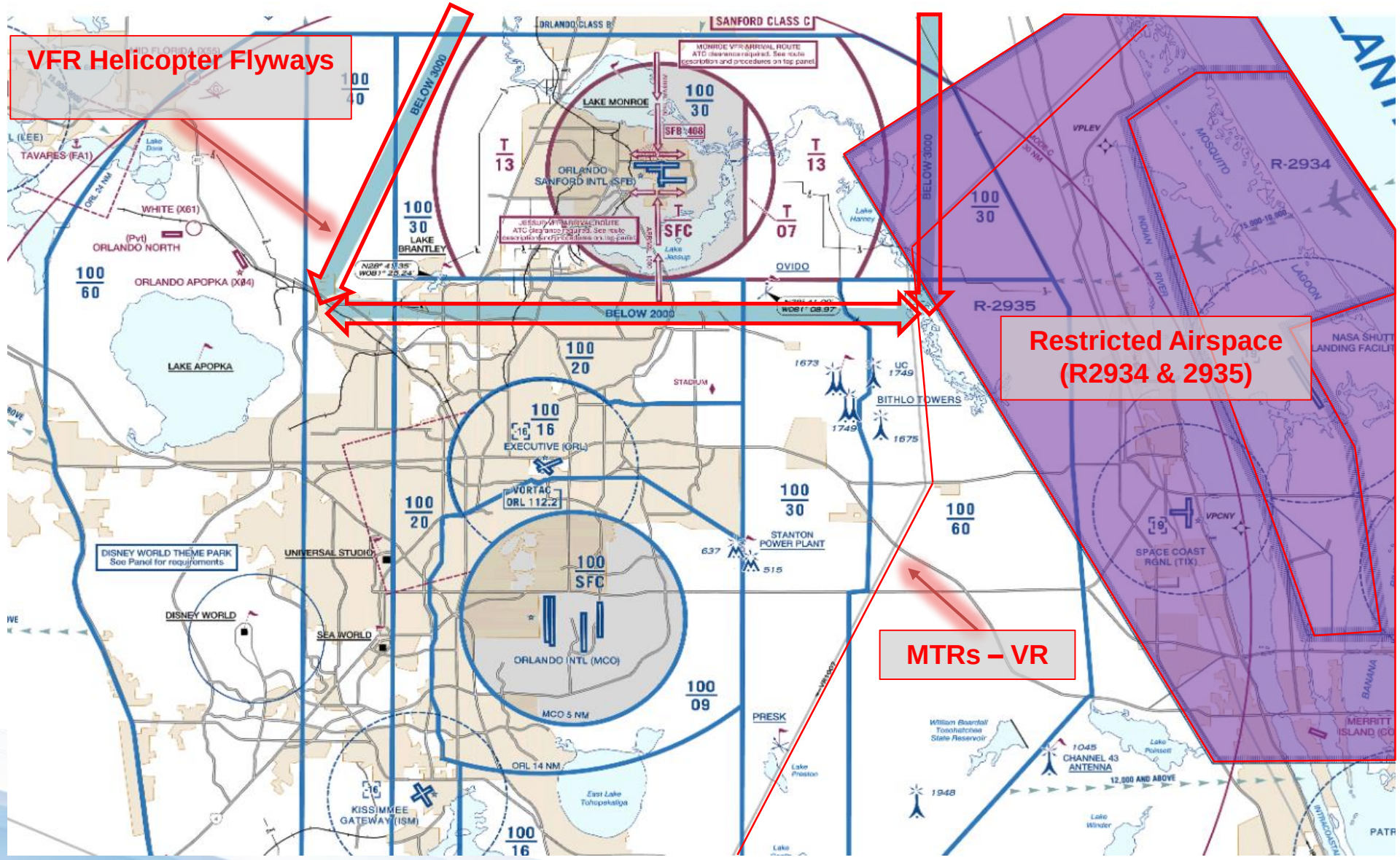

Helicopter Routes BOS Example

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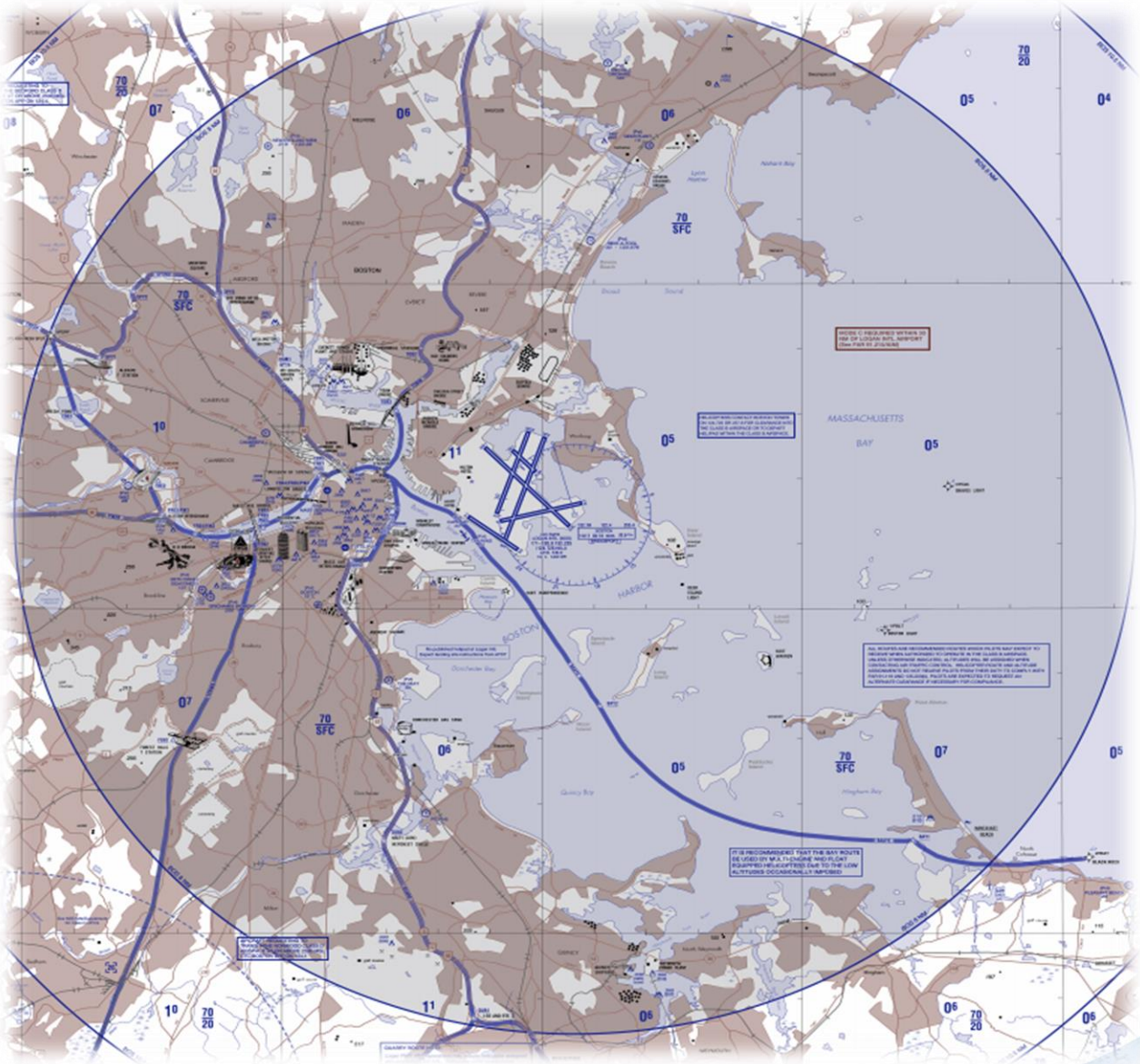
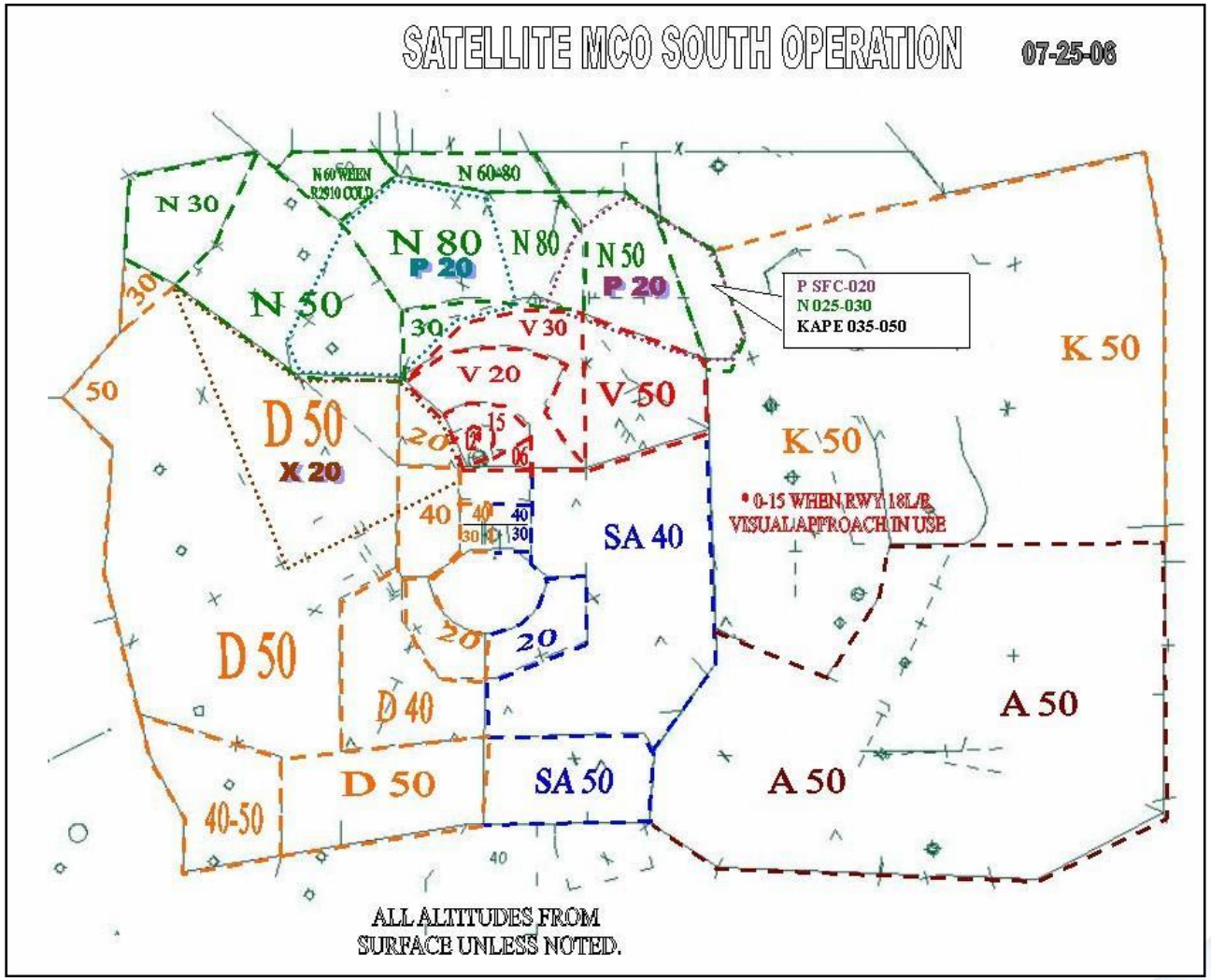
- **Helicopter route (procedures) are not the same at all locations**
- **Some areas assign altitudes, others separate by geography (south of the river, etc.)**
- **Established structure through Class B airspace provides stability for operations**



Satellite Position

- **Provides Radar services to aircraft circumnavigating the Airport traffic area**
- **Provides VFR flight following services to aircraft on request and workload permitting**
- **Practice Approach services at satellite airports**
- **Accommodates special activity flights in their stratum**
- **Assists lower altitude aircraft get to the primary airport**



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